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STUDIES IN ASTEREOGNOSIS.

SUMMARY OF THE RESULTS OBTAINED IN ONE HUNDRED AND FOURTEEN MISCELLANEOUS CASES OF NERVOUS DISEASE.*

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The subject of astereognosis[1] is one of increasing importance and one which has not as yet received the attention which it merits. Many years ago B. Puchelt,[2] in 1844, directed attention to several cases in which the patient was unable to recognize foreign bodies by touch, although cutaneous sensibility was more or less preserved. Long after, Hoffmann,[3] in 1883, again took up the subject. He studied sixteen cases, in a majority of which the symptom was present. More recently Wernicke,[4] Monokow,[5] Burr,[6] Dubbers,[7] Olmstead,[8] Sailer,[9] Williamson,[10] Vorster,[11] and Dejerine and Egger,[12] have described cases in which the same symptom was present. It occurred to the writer that it would be of value to carefully examine a large number of miscellaneous cases of diseases of the nervous system with reference to this symptom. In most of the cases thus far reported a lesion of the cerebrum was either definitely determined or the symptoms pointed to the cerebrum as the seat of the disease. At the last meeting of the American Neurological Association the writer reported a case of tumor of the oblongata[13] in which astereognosis was present, and it was especially the findings in this case which suggested a study of the subject in the hope that some conclusions, first as to the factors which enter into astereognosis, and secondly as to the clinical value of the symptom, might be reached.

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[1] The word stereognostic was invented by Hoffmann and first employed by him in "Stereognostische Versuche." It is derived from *στερεόσ*, solid, and *γιγνωσκω*, to know. The words stereognosis and astereognosis were, I believe, first used by myself in the presentation of the case of tumor of the oblongata. Stereognosis would, of course, mean the faculty of being able to recognize foreign bodies and astereognosis would imply the absence or loss of this faculty.

[2] Medicinische Analen, X Bd., IV Heft, Heidelberg, 1844, p. 485.

[3] Herman Hoffmann, "Stereognostische Versuche," Inaug. Dissertation, Strassburg, Kontanz, 1883.

Hoffmann pointed out that a large number of factors entered into stereognostic perception. These factors he separated into the tactile sense, the sense of location of tactile impressions, the sense or faculty of distinguishing two simultaneous impressions,[14] the pressure sense, the muscular sense, the temperature sense, the pain sense, the sense of knowledge of the position of the fingers to each other and to the hand, the recognition of passive movements and the recognition of active movements. The writer found, that for practical purposes it was best to separate the examination into the tactile sense, the temperature sense, the pain sense, the pressure sense, the sense of weight or muscular sense, the sense of location (that is, the ability of the patient to correctly refer the impression to the point or area touched), the knowledge of the patient in regard to the position of the fingers, the condition of the fingers and hands as regards mobility, and lastly, but most important of all, the ability of the patient to distinguish one or more impressions made upon the hand and fingers at one and the same time, and to this faculty the writer proposes the name of the *spacing sense.* The faculty of perceiving objects by means of the hands is an exceedingly complex one, and an effort was made to determine if possible something as to the relative importance of the various factors here enumerated.

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[4] "Arbeiten aus der psychiatrischen Klinik in Breslau," Leipzig, 1895; also Monokow, "Gehirnpathologie," Nothnagel, Wien, 1897, p. 409.

[5] Monokow, "Gehirnpathologie," Nothnagel, Wien, 1897, pp. 410 and 411.

[6] Burr, JOURNAL OF NERVOUS AND MENTAL DISEASE, Jan., 1898.

[7] Dubbers, Neurologisches Centralblatt, 1897, p. 61.

[8] Olmstead, JOURNAL OF NERVOUS AND MENTAL DISEASE, Nov., 1898.

[9] Sailer, JOURNAL OF NERVOUS AND MENTAL DISEASE, March, 1899, p. 161.

[10] Williamson, British Medical Journal, 1897, II, p. 787.

[11] Vorster, Archiv f. Psychiatrie, Bd. XXX, No. 2, 1898, p. 341.

[12] Dejerine et Egger, Revue Neurologique, 1899, p. 891.

[13] Dercum, JOURNAL OF NERVOUS AND MENTAL DISEASE, August, 1899.

[14] "Raumsinn or space sense."

The objects used in making the tests were small cubes, oblong blocks of wood, marbles, balls, pebbles and common household and personal articles, such as spoons, thimbles, penknives, spools, scissors, nails, screws, etc. The patients' eyes were, of course, always bandaged during the tests.

In all the writer examined one hundred and fourteen miscellaneous cases in the nervous wards of the Philadelphia Hospital. Among the diseases studied were hemiplegia, diplegia, posterior sclerosis, ataxic paraplegia, myelitis, syringomyelia, multiple sclerosis, cerebro-spinal syphilis, multiple neuritis, epilepsy, paralysis agitans, alcoholism, chronic lead poisoning, senile tremor, traumatic neurosis and chronic rheumatoid arthritis. It was thought best, also, because of the large number of cases studied, not to present here detailed histories of cases, but merely a brief statement of the results obtained.

The investigation was limited to the ability of the patient to recognize objects by the hand. The hand is, of course, the principal organ of the stereognostic sense, although this faculty is not limited to the hand, but is shared to some extent by the soles of the feet, and to a smaller extent by the general surface of the body.

HEMIPLEGIA.—Beginning with hemiplegia, the number of cases examined was forty-nine. Of these eight were rejected because the mental condition either on account of the lesion or the age of the patient was such as to make an accurate study impossible. This reduces the actual number of cases to forty-one. In examining cases of hemiplegia it should be stated the results obtained in the paralyzed hand were always compared with those obtained in the hand of the healthy side. In the forty-one cases it was rather surprising to find astereognosis present in twenty, *i. e.*, in almost one-half. In these twenty cases the astereognosis was found to be incomplete or partial in seven and complete or total in thirteen.

Studied in detail these thirteen cases revealed the following remarkable facts: The tactile sense was lost completely in only three. It was more or less preserved in ten; it was completely preserved in six and partially preserved in only four. In these ten cases the temperature sense was preserved in five and diminished in five; it was lost in none. The pressure sense was preserved in six, diminished in four and lost in none. The pain sense was preserved in five, diminished in five and lost in none. The spacing sense, on the other hand, revealed a very great degree of loss. Of the entire thirteen cases of total astereognosis, the spacing sense was lost in ten; it was preserved in one, diminished in one and not satisfactorily examined in one because of aphasia. These results are the more remarkable when we reflect that in these thirteen cases the tactile sense was lost in only three, while the other senses were, as we have just stated, preserved in varying degrees. In two only of these thirteen cases could the astereognosis be ascribed to a general anesthesia, *i. e.*, to a loss of all forms of sensation. In one case there was anesthesia to the tactile sense and to the temperature sense, but merely hypesthesia to the pressure sense, together with full preservation of the pain sense. The preservation of the pain sense and the pressure sense in this case was of no value in enabling the patient to perceive foreign bodies. In four of the thirteen cases all of the cutaneous senses, the tactile, the temperature, the pain and the pressure senses, were preserved, except the spacing sense. This was completely lost, and to this loss the astereognosis appeared to be due. In two others of these thirteen cases there was diminished tactile, temperature, pain and pressure senses, together with loss of the spacing sense. In another case there was hypesthesia to the tactile, temperature and pain senses, while the pressure sense was fully preserved, but here again the loss of the spacing sense gave rise to astereognosis.

In only one case, in which astereognosis existed, was the spacing sense preserved. In this case there was present in addition to the spacing sense a fully preserved tactile sense, a slightly diminished temperature sense, a preserved pressure sense and a very good power to estimate weight. There was, however, a decided loss in the ability to correctly refer the cutaneous impressions to the part touched, and a marked impairment of the power to describe the position of the fingers when the eyes were closed; in addition, there was present also a marked secondary contracture of the hands and fingers. Of the remaining two of this group of thirteen cases, one presented a marked hypesthesia of all the cutaneous senses together with marked secondary contracture, and the last a preservation of the various forms of cutaneous sensibility, but with loss of the power of location. The last mentioned case also suffered from a partial motor aphasia, and it was difficult to determine the condition of the spacing sense. The latter was, however, undoubtedly disordered. It is interesting in connection with this patient to state that he could readily distinguish objects with his left hand, which was the hand of his sound side. If when his eyes were bandaged an object were placed in his left hand and then placed among a number of other objects, the bandage having been removed, he could then correctly select the object which he had formerly held in his left hand. With the right hand this test invariably failed, proving the undoubted co-existence of astereognosis with the aphasia.

The various values of the sensory phenomena present in astereognosis as observed in these thirteen cases of hemiplegia can be gleaned from the following statements: The tactile sense was studied in twenty cases of complete and partial astereognosis; it was preserved in eleven, diminished in six, and lost in three. The temperature sense was studied in nineteen cases and was found preserved in ten, diminished in six and lost in three. The pressure sense was studied in eighteen cases and was found preserved in ten, diminished in six and lost in two. The pain sense was studied in eighteen cases and was found preserved in ten, diminished in five and lost in three. The sense of weight was studied in ten cases and found preserved in five, diminished in three and lost in two. The sense of localization, *i. e.*, the power of correctly referring the impression to the part touched, was studied in six; it was found preserved in two and lost in four. The power to correctly describe the position of the fingers, the eyes being closed, was tested in nine and found preserved only once, diminished in six and lost in two. The spacing sense, the power to separate or distinguish multiple impressions, was studied in sixteen and was found preserved in only four, diminished in two and lost in ten. Very marked secondary contracture existed in ten cases. In one case there was present athetosis, but the value of this symptom in causing astereognosis is open to doubt when I add that in this case there was also loss of the spacing sense, all of the other cutaneous senses being preserved.

Secondary contracture of itself was found to be insufficient to determine astereognosis. In one case in which the contracture was excessive and in which there was present no voluntary motion of the fingers, all of the cutaneous sensibilities being preserved, together with the spacing sense, stereognosis was but slightly impaired; this patient, I should add, however, was an unusually bright woman. She could recognize a key or other complex body laid on the back of her hand or upon her fingers with great readiness. Further contracture even when associated with marked athetoid movements is not sufficient to determine astereognosis. In a young woman, aged twenty-eight, suffering from spastic infantile hemiplegia, there was present marked contracture of the left hand with marked and ceaseless athetosis. Notwithstanding, there was present complete stereognostic perception in this hand.

Loss of the sense of weight alone is insufficient to determine astereognosis. In a case of hemiplegia with marked secondary contracture but with full preservation of all of the cutaneous senses, there was present a loss of the sense of weight. The patient could accurately describe various articles placed in his hands, but every now and then would make gross errors in attempting to describe their weight. This would occasionally lead him to describe a piece of wood resting upon his hand as a piece of iron, but even then he would accurately describe its shape.

One of the most remarkable findings occurred in a case of hysterical anesthesia. This patient was presented before the Section on Internal Medicine of the College of Physicians by my colleague, Dr. Burrr, but the case has, I believe, never been published by him. The history is briefly as follows: The patient was a woman, white, thirty years of age, who suffered from left-sided hemiplegia. The arm was merely paretic and its mobility varied at various times. There was no, or very slight, spasticity of the leg. The knee-jerks were slightly increased. There was no ankle-clonus. There was no contracture in either the arm or the leg. There was complete anesthesia in the entire left half of the trunk, the left arm and the left leg. The patient slightly dragged her left leg in walking and at times walked very much better than at others. The case was regarded as hysterical, and, being tested for the stereognostic sense, revealed the following remarkable condition: The tactile sense, the temperature sense, the pressure sense and the sense of weight and, of course, of necessity, the spacing sense, were lost. She also knew nothing of the position of the fingers. When, however, complex bodies, such as a key, scissors or a pen-knife, were placed in the paralyzed hand, she instantly recognized and correctly named the object. She was examined repeatedly and only made occasional errors. These arose, however, always in reference to the weight of bodies. For example, while she described accurately the shape of a piece of card-board, she declared that it was a piece of sheet iron. This error she made repeatedly. When we consider the fact that the left side was paretic, although the hemiplegia was hysterical, it is suggestive, to say the least, that the only factor of the stereognostic sense which was really lost, was the sense of weight. The preservation of the stereognostic sense in the hemianesthesia of hysteria is not altogether unknown, but it is certainly excessively rare. Hoffmann made a similar observation in hysterical anesthesia. (Case XV.)

It may be worth while to briefly restate my findings in the forty-one cases of hemiplegia. In twenty cases astereognosis, more or less pronounced, was present. In eight cases the patients suffered from right-sided hemiplegia and in twelve from left-sided hemiplegia. That this proportion has, however, no clinical value, is revealed by the fact that a similar proportion was found between my cases of right and left hemiplegia in which no astereognosis existed.

Before dismissing the cases of hemiplegia, let me suggest that it would be most interesting to study astereognosis in cases of aphasia. It would be very difficult, but the method by which it may at least occasionally be accomplished, I have already indicated.

DIPLEGIA.—Five cases of diplegia of childhood were studied. In two the stereognostic sense was markedly defective, apparently because of excessive athetoid movements. In another, while marked athetosis and contracture existed upon both sides, astereognosis was found only upon one, and an examination of this side revealed a complete hemianesthesia, a total loss of all forms of sensation. In a third case of diplegia, due to internal hydrocephalus, astereognosis existed in the right hand only. In this case the various cutaneous senses were preserved, but to what extent the patient's intelligence did not permit me to determine, and it was unfortunately not possible to determine the cause of the astereognosis. Probably it was purely cortical in origin. In the remaining two cases of diplegia, there was no stereognostic loss whatever.

LOCOMOTOR ATAXIA.—Sixteen cases of locomotor ataxia were studied. Astereognosis existed in five cases and in both right and left hands. It was total only in three and partial in two. As in the cases of hemiplegia, the hands alone were studied. In three cases in which complete stereognostic loss existed, the tactile sense was preserved in one and diminished and retarded in two. The temperature sense was preserved in all. The pressure sense was diminished in all. The pain sense was preserved, but slightly diminished in all. The spacing sense was much diminished in two and entirely lost in one. The sense of weight was much diminished in one, slightly diminished in one and lost in the third. The sense of location was preserved or but slightly diminished in all; it was not lost in any. The ability to recognize the position of the fingers was lost or greatly diminished in all three. Marked ataxia of the hands and arms existed in all three. In two cases in which the astereognostic loss was pronounced, but not complete, the tactile sense was preserved in both with retardation in one.

The temperature sense was preserved in both. The pressure sense was preserved in one and diminished in the other. The pain sense was preserved in both. The spacing sense was much diminished in both. The sense of weight was diminished in one and lost in the other. The sense of localization of impressions was preserved or but slightly diminished in both. The ability to recognize the position of the fingers was diminished in both. Both cases presented marked ataxia of the hands and arms. In the eleven cases of locomotor ataxia in which there was no stereognostic loss, the examination of the various forms of sensation in the hands yielded negative or inconclusive results.

In studying the findings in the cases in which astereognosis existed, we are impressed with the fact that as in the astereognosis of hemiplegia, the spacing sense was much involved; though not lost, it was diminished in all five cases. It is very probable, however, that the ataxia and the diminution of the knowledge of the position of the fingers were also of great importance in determining the astereognosis.

Ataxic Paraplegia.—Three cases of ataxic paraplegia were studied. Astereognosis was present in two; absent in one. In the two cases in which astereognosis existed, the tactile, temperature, pain and the pressure senses were preserved in both. The spacing sense was lost in both. The sense of weight was diminished or imperfectly preserved in both. The sense of localization was preserved in both. The knowledge of the position of the fingers was much diminished in one and lost in the other. Marked ataxia of the hands and arms existed in both. Here again we are impressed by the loss of the spacing sense, although the diminution of the knowledge of the position of the fingers as well as the ataxia must as in tabes be of importance.

Multiple Neuritis.—Two cases of multiple neuritis were studied. In one astereognosis was present in both hands. In the other no astereognosis existed. In the case in which the astereognostic sense was lost, both hands were studied as follows: In the right hand, the tactile sense was diminished and retarded. The temperature sense was preserved. The pressure sense was lost. The pain sense was hyperacute. The spacing sense was lost. The sense of weight was lost. The sense of location of impressions, strange to say, was preserved. The knowledge of the position of the fingers was lost. In the left hand the tactile sense was preserved, as were also the temperature and pressure senses. The pain sense, as in the right hand, was hyperacute. The spacing sense was greatly diminished. The sense of weight was lost. The sense of localization, the pressure sense and the knowledge of the position of the fingers, as in the right hand, was lost. Here again the loss or great diminution of the spacing sense is the striking feature, although the absence of the power to appreciate the position of the fingers must also be regarded as of importance.

In all the other cases of nervous disease which were studied, eighty-three in number, no astereognosis was discovered. Thus, astereognosis was absent in five cases of myelitis, in five cases of multiple sclerosis, in three cases of cerebro-spinal syphilis, in one case of syringomyelia, in five cases of paralysis agitans, in eleven cases of epilepsy and also in the various other affections enumerated at the beginning of this paper.

CONCLUSION.—The above studies appear to justify the following conclusions:

First—It would appear that the loss or impairment of the spacing sense is the most important factor in determining astereognosis. It must be remembered, however, that astereognosis may exist though the spacing sense be preserved. In the single case of hemiplegia in which this was the case there was, however, a loss of location, a loss of the knowledge of the position of the fingers and marked secondary contracture.

Second—Next in importance to the spacing sense appears to be the knowledge of the position of the fingers and ataxia of movement.

Third—The mere preservation of the ability to perceive tactile impressions and the preservation of the pressure, temperature and pain senses is insufficient to prevent stereognostic loss.

The question next arises, is it possible to draw any conclusions of clinical value? It is evident, of course, that astereognosis may be due to lesions of the brain, of the medulla (author's case), of the cord, and of the peripheral nerves. Further, astereognosis must be of two kinds, peripheral or central; that is, it must be due either to an interruption of the pathways, the peripheral nerves or cord, by means of which the various sensory impressions reach the brain; or these pathways being open, it must be due to some lesion of the cortex. In many cases astereognosis is undoubtedly cortical. This is undeniably the case in dementia; it was also the case in a brain tumor involving the cortex, reported by Drs. Mills and Keen at this meeting. Now if astereognosis be at times cortical and at times peripheral, are there any means by which the symptom can be made of differential value?

Our present knowledge forbids a positive answer. It is not, however, impossible that it may be so employed. The various impressions received by the cortex from all of the various sources concerned in stereognostic perception must be combined in the cortexto give rise to the mental picture of the object felt. Given a case in which the various factors known to be important to stereognostic perception are all preserved and notwithstanding astereognosis exists,it would be justifiable to infer that the origin of the symptom is cortical. Again if with astereognosis there be specific or isolated losses, such, for instance as a loss of the sense of weight, or of the position of the fingers, or ataxia of movement without the signs of peripheral nerve or cord disease, it would, other things equal, justify the inference of brain or cortical involvement. Indeed, such a loss would indicate not merely cortical involvement; it would point directly to a special area of the cortex, namely, the posterior portion of the superior parietal lobule.

As to how much loss of the spacing sense depends upon nerve, cord or brain involvement, it is impossible to say. It appears to be present in astereognosis dependent upon lesions in any of these situations, and yet the function implied by the spacing sense is probably purely cortical. If we analyze the cases of locomotor ataxia and multiple neuritis in which the spacing sense is lost, we find that the tactile sense is generally either impaired or retarded, so that in them the loss of the spacing sense may be merely the expression of a tactile hyperesthesia.